

Desinging of 3D Seismic Survey And Data Processing of Abu Amood Oil Field Southern of Iraq

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Abstract —3D seismic reflection study was applied to Abu Amood oil field which is located to the southern part of Iraq within Dhi Qar province that carried out by oil Exploration Company to an area 1534.88 Km² for studying Nahr Umr Formation. Field tests was the first stage in exploration to determination the best standard to get the better records of signal to noise ratio which is given for instruments to act on it to get better results: In the field of Abu Amood there are three main of field tests (noise test, signal test and geometry distribution pattern of vibrators). According to field tests the seismic selected the standard field to accomplish of the survey program. The pre-planning of the survey, the second step in oil exploration crew used specific design that ensures of execution with high quality of seismic recorded data. The processing of seismic data were carried out using Omega ve 2.7 included processing the following steps:- (Reformatting, Geometry defines, Gain (Spherical Diversions), Static Correction (Elevation Static), AMPSCAL (Noise Suppression by Amplitude Scaling) or (Random Noise Attenuation), TMDDF(Trimmed Mean Dynamic Dip Filter), SCAC (Surface Consistent Amplitude Compensation), Surface-Consistent Deconvolution, CMP Sort, Stack Velocity Analysis (First Pass) , Residual Static Correction Calculation and Application, Normal Move Out Correction / Mute / Stack, Post Stack Time Migration).

Keywords —Field test, standardfield, geometry distribution pattern of Vibrators, Abu Amood oil field.

I. INTRODUCTION

The Rafidain field is located in the province of Dhi Qar, about 16 km north of Qall'at Sukkar area, it is about 26 km north of the Refa'i area. The field is located 17 km southwest of the Dejaila field [1].

According to O.E.C plan in 2012 the second seismic crew has carried out 3D seismic survey of Abu Amood Oil field in 2012/6/26, the survey area was 1534.88 Km²[2].

The current research is about updating and developing of Abu Amood oil field, which deals the interpretation of Abu Amood oil field and analysis the seismic reflection

data in the oil field structurally and stratigraphic [3][4][5]. Before interpretation work, it is necessary to review briefly the field requirements of the 3D at Abu amood survey[4][5], the processing which was carried out in the Oil Exploration Company.

II. METHODOLOGY

- 1- Field tests was carried out to get the best standard and better records of signal which is given for instruments to act on it to get better results.
- 2- Standards field distribution and geometry distribution pattern of vibrators
- 3- Designing the pattern survey.
- 4- Seismic data processing after survey.

III. FIELD TESTS

The field tests has been done for getting the best standard and better records of signal which is given for instruments to act on it to get better results. In the field of Abu Amood there are three main of field test: noise test, signal test and geometry distribution pattern of vibrators [6][7]. Then choosing the best of the receiver line to do the test as shown in figure (1).

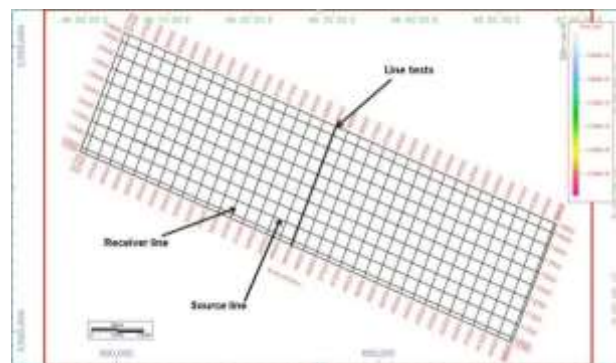


Fig.1: location of the receiver line for test at Abu Amood oil field [8].

- 1- Noise test :- Location were installed for receivers and source as shown figure (2)
 - Deployment of 100 clusterof receivers points .

- Using 4 vibrators as a source of energy as shown figure (3)



Fig.2: Schematic illustration of distribution pattern for noise test[8].

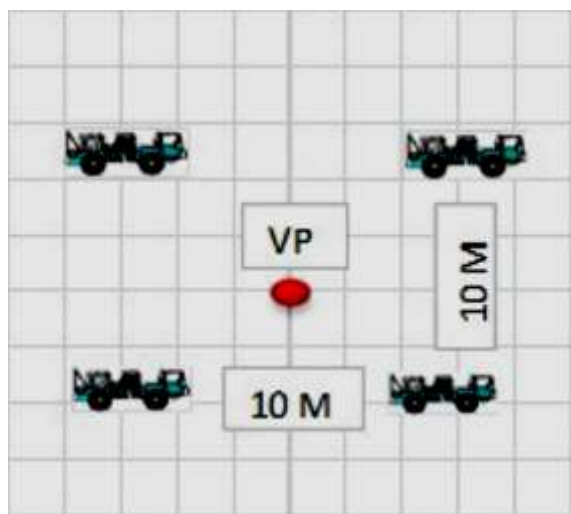


Fig.3: Illustrate the distribution of vibrators pattern around the receiver point [8].

2- Signal test:

Distribution two line of test, the first line was of length 44m and distance between two geophones 4 m as shown in figure (4) and the second line was of length 55 m, and the distance between two geophone 5 m as shown figure (5).

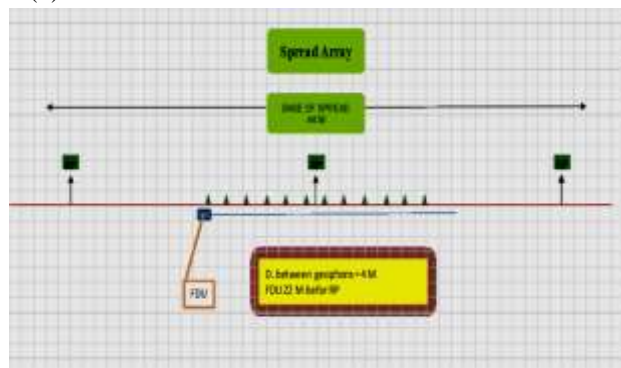


Fig.4: The first line distribution of geophone [8].

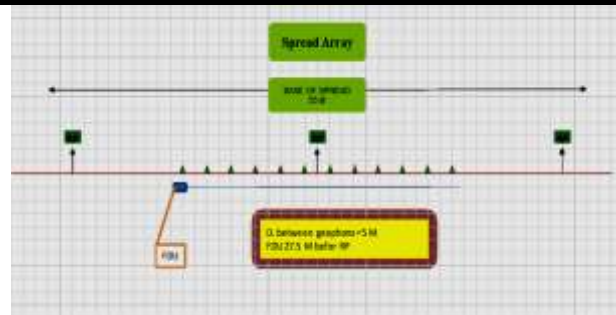


Fig.5: The second line distribution of geophones [8].

3- Geometry distribution pattern of vibrators:

In this test the crew seismic used three distribution pattern of vibrator as shown figures (6)(7)(8).

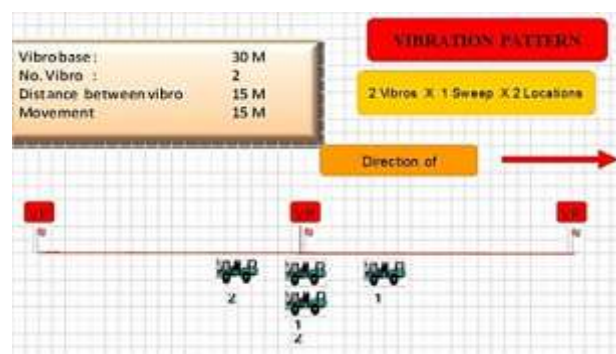


Fig.6: Shows the distribution of vibrators (2*1*2)[8].

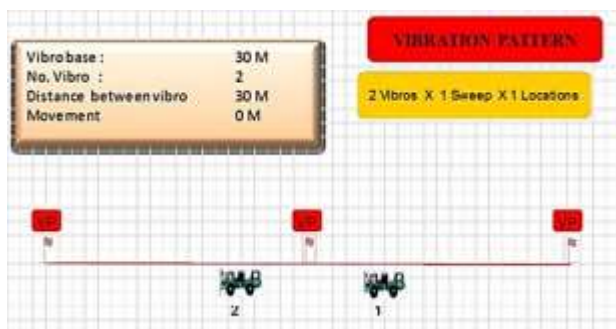


Fig.7: Shows the distribution of vibrators (2*1*1)[8].

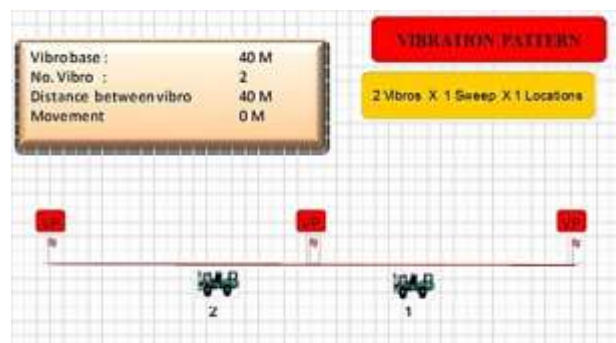


Fig.8: Shows the distribution of vibrators (2*1*1)[8].

4- Standard field

According to the tests above the crew seismic chose the length of line distribution and geometry distribution pattern of vibrators as shown figures (5)(7). And according to the following standard to accomplish the survey program (table 1,2,3,4) represent standard of field spread, source, receiver and type of recorder consistently that were used in Abu Amood oil Field.

Table.1: Shows the parameters of Spread [8].

Type	3D, symmetrical split spread (84+84)
Number of Receiver Lines	18
Number of active channels per receiver line	168
Receiver stations interval	50 m
Source stations interval	50 m
Source line spacing	300 m
Receiver lines spacing	300 m
Bin size	25X25 m
In-line roll	1 receiver line after 6 VP's per salvo
Nominal CDP fold	126

Table.2: Shows the parameters of source [8].

Type	Vibrators
Model	Nomad 65
Control electronics	Sercel VE432
Number of vibrators in source pattern	2
Geometry of pattern	In-line with source line
Physical pattern length	30 m
Distance between pads	30 m
Sweep type	16 Hz -74Hz linear
Sweep length	12 s
Sweep start and end taper length	300 ms
Number of sweeps per location	1
Drive level for production	70-75 %
Servo mode	Raw
Polarity of Ground Force signal	SEG

Table.3: Shows the parameters of receiver [8].

Type	Sensor SG-10 (12 geophones)
Geophone string	12 sensors (connected

configuration	in series)
Number of strings per pattern	1 string
Geometry of pattern	linear
Pattern dimensions	55 m

Table.4: Shows the parameters of recording instrument [8].

Type	Sercel 428UL
Tape format	SEG-D
Sampling interval	2 ms
Record length, correlated	5 s
Field processing	Correlation after stack
Polarity of seismic data channels	SEG

IV. PROCESSING SEQUENCE OF SEISMIC DATA

The seismic data were processed at the processing center of the oil Exploration Company. The primary objective is to enhance the quality of the recorded data with special regard to the 3D data. Basically, this improvement is essential to facilitate the structural and stratigraphic seismic interpretation. The noise attenuation process leads to improve reflection continuity and enhance the ability to compute seismic attributes. The processing of seismic data was carried out using Omega ve.2.7 [8] Included processing the following steps:-

1- Reformating:-

The seismic data which was supplied in SEG-D format was first, converted internal seismic file format (PARADIGM FORMAT), and then the data was checked using the transcription program print out file, the input and output record number matched with the observer information. The data was extracted with 5000 ms record length and 2ms sampling rate [8].

2- Geometry defines:-

Geometry information was received in the (SPS) file format. A geometry data base was built using this information; many maps were displayed in attribute display utility to Quality Control (QC) the SPS file information as shown in Figure (9).

The geometry data base was updated with filed data information of shots using the geometry update , so old headers were updated, new headers were added, subsurface was built due to surface information [9][10].

3- Gain (Spherical Diversions):-

The geometrical spreading compensation was applied in shot gather to recover decay in amplitude caused by geometric divergence. An RMS constant velocity function

was used to compute V^2T amplitude compensation function [9][10] Figures (10) (11).

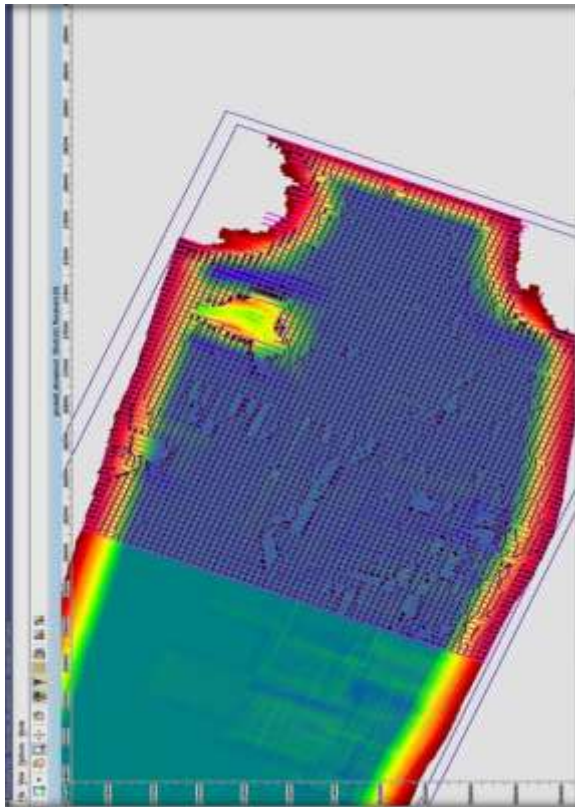


Fig.9: Geometry_QC: processing survey map represent shots and receivers location for the whole survey (as read from SPS file) in Abu Amood oil field [8].

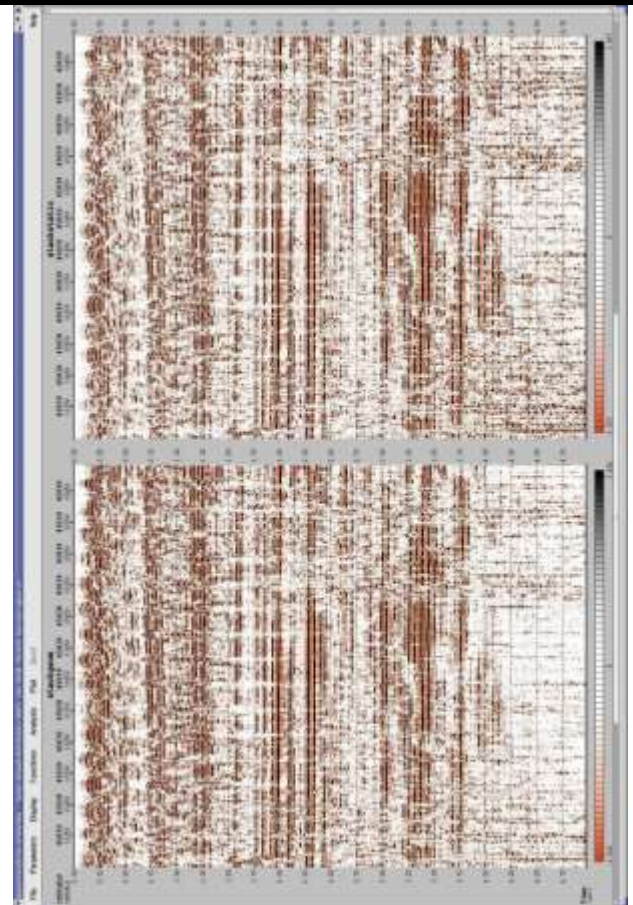


Fig.11: Stack Inline 45030 before and after Gain (Spherical Diversions) in Abu Amood oil field [8].

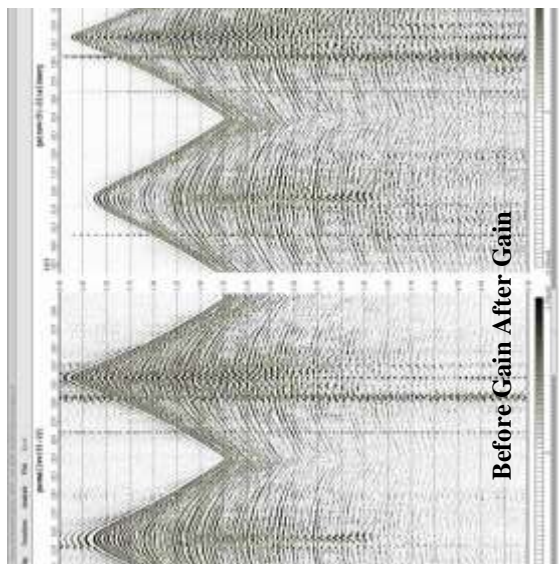


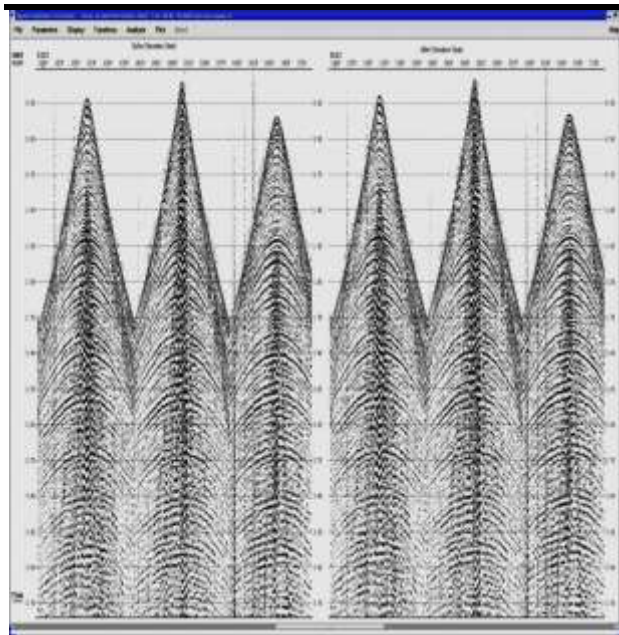
Fig.10: Shot gathers before and after GAIN (Spherical Divergent) in Abu Amood oil field [8].

4 -Static Correction (Elevation Static) :-

Elevation Static was calculated using (weathering velocity, surface elevation, shot elevation and datum elevation) information that were acquired in conjunction with Abu Amood-3D seismic survey [9][10] Figure (12).

5- AMPSCAL (Noise Suppression by Amplitude scaling) or (Random Noise Attenuation):-

AMPSCAL is designed to attenuate noise bursts, cable slashes, air blasts, and frost breaks. The data are analyzed across small overlapping spatial and temporal windows by comparing the window amplitude with the amplitude of corresponding window on neighboring traces in the dataset. Windows with anomalously high amplitudes are scaled down [9][10]. Figures (13),(14).



Before After
 Fig.12: Shot gathers before and after elevation Static Correction in Abu Amood oil field [8].

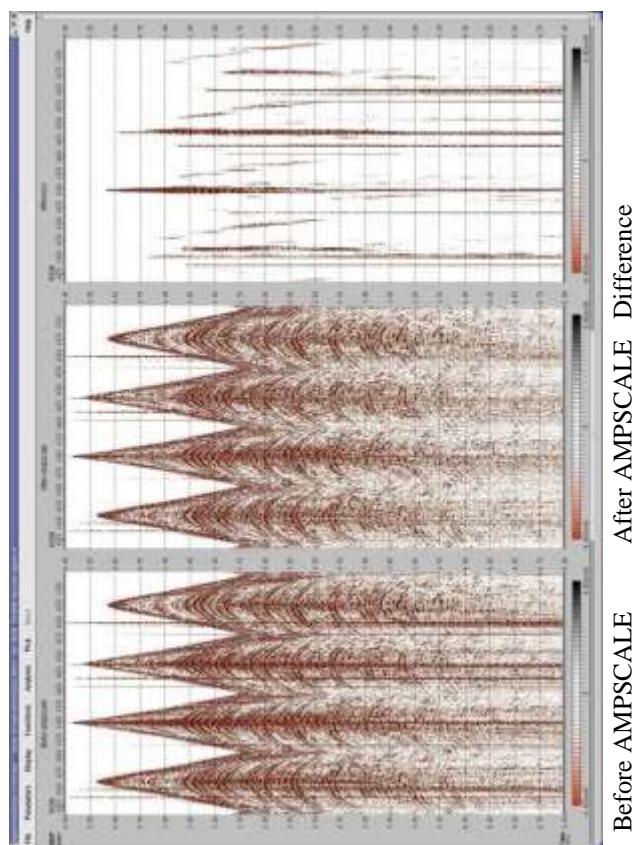


Fig.13: Shot gather before , after AMPSCALE and the difference in Abu Amood oil field [8].

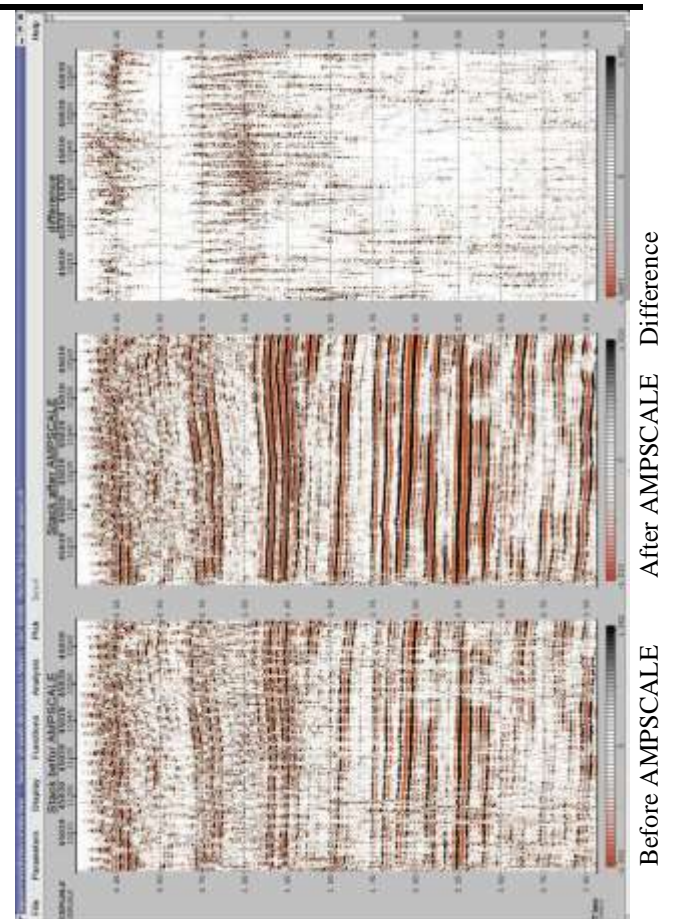


Fig.14: Stack Inline 45030 before and after AMPSCALE in Abu Amood oil field [8].

6-TMDDF(Trimmed Mean Dynamic Dip Filter) :-

TMDDF processes pre-stack data sets to improve the signal-to-random-noise ratio. At each sample of each trace it computes a series of trimmed means along rays (dips), using the sample it self (start and end of dip) traces. The output sample is the trimmed mean that yields the highest amplitude. The object of TMDDF processing is to remove high amplitude noise and locally weak coherent events without eliminating useful trace information [9][10]Figure (15) (16).

7- SCAC (Surface Consistent Amplitude Compensation):-

Amplitude Correction (Acquisition Problem) it was seen that a different portion of the data has amplitude values that are lower than the rest. SCAC is analysis tool to determine a scalar to apply that would bring the low amplitude portion of data to the same RMS amplitude as the rest of the data. It compensates for shot, detector and offset amplitude variation that is caused by acquisition effects and are not a consequence of the subsurface geology [9][10]Figures (17) (18).

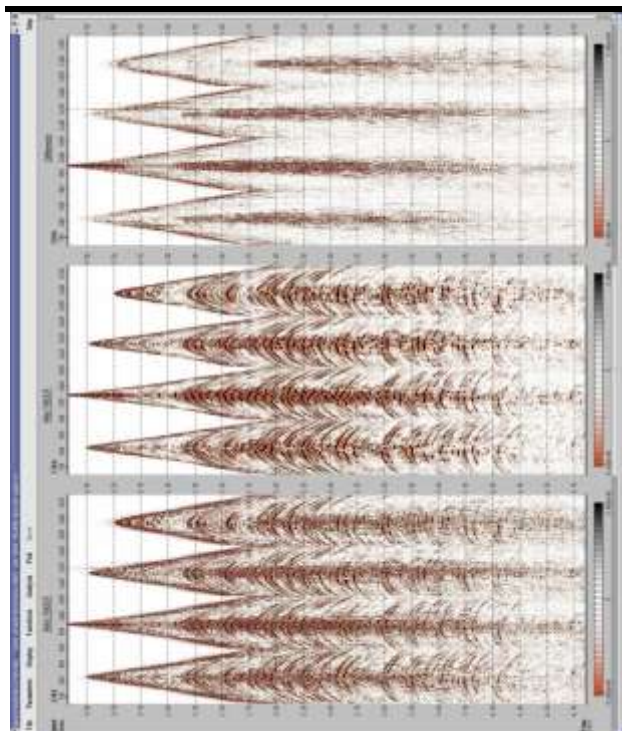


Fig.15: Shots gathers before and after TMDDF as well as the difference in Abu Amood oil field [8].

Before TMDDF After TMDDF Difference

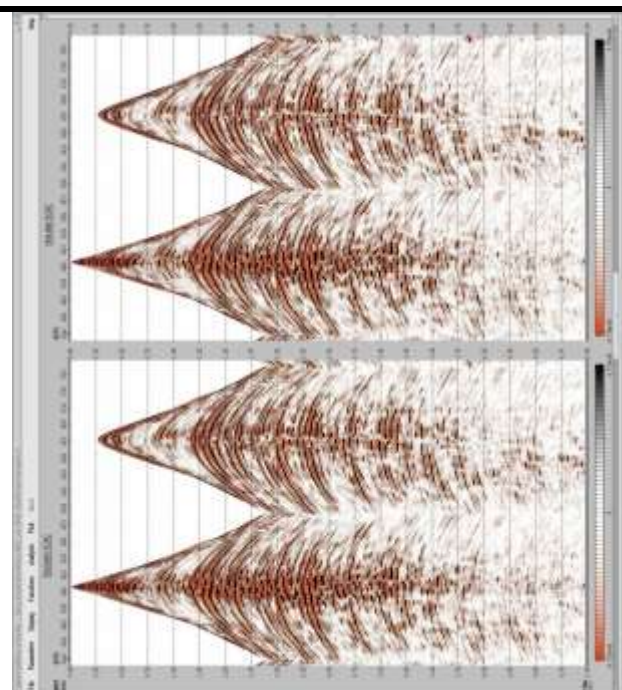


Fig.17: Shots gathers before and after SCAC in Abu Amood oil field [8].

Before After

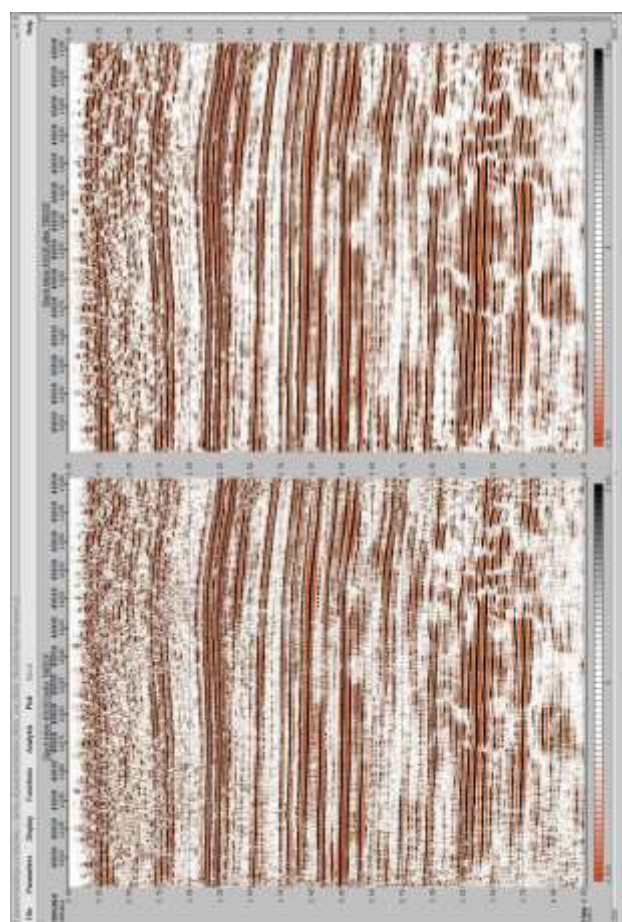


Fig.16: Stack Inline 45030 before and after TMDDF in Abu Amood oil field [8].

Before TMDDF After TMDDF

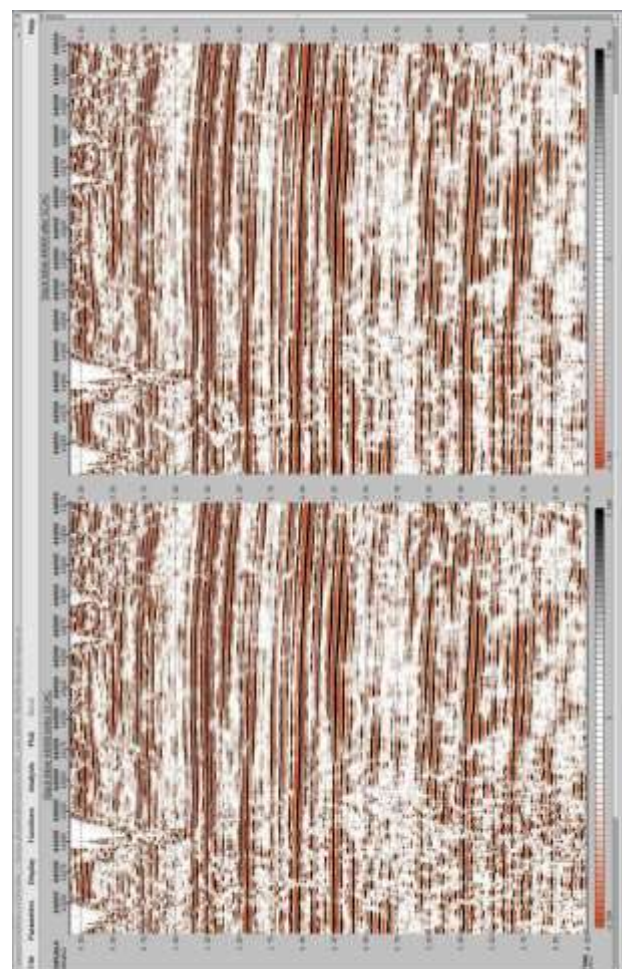


Fig.18: Stack Inline 44000 before and after SCAC in Abu Amood oil field [8].

Before After

8- Surface-Consistent Deconvolution:-

Surface-consistent deconvolution is applied to seismic data to selectively remove the convolutional components contributing to the seismic wavelet. The process is typically more robust than conventional single channel deconvolution, particularly in the presence of noise, since the noise contributes to the operator phase instability and yields residual wavelets that are noise dependent. Surface-consistent deconvolution reduces the operator's sensitivity to noise by averaging the amplitude spectra of the components of the wavelet. Deconvolving the seismic data with surface consistent operators results in residual wavelets that fit the surface-consistent model, consequently, is more suitable for subsequent residual statics computations. The modules (SURFAN, SURFAUT, and SURFDEC) provide a surface-consistent solution that is appropriate for application with both 2D and 3D data sets [9][10]Figures (19, 20, 21).

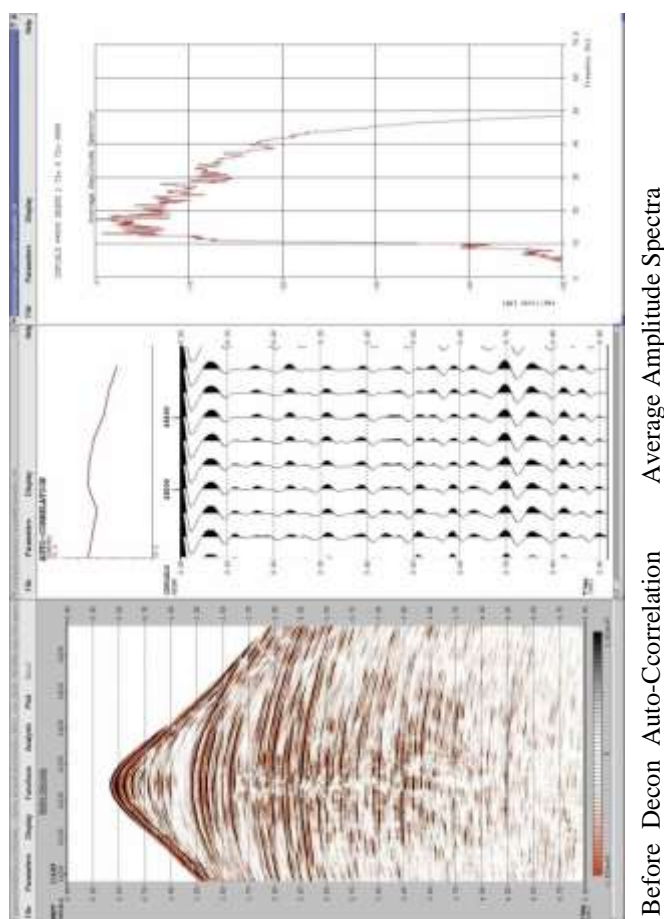


Fig.19: The autocorrelation and the spectral analysis for the shot before apply DECON in Abu Amood oil field [8].

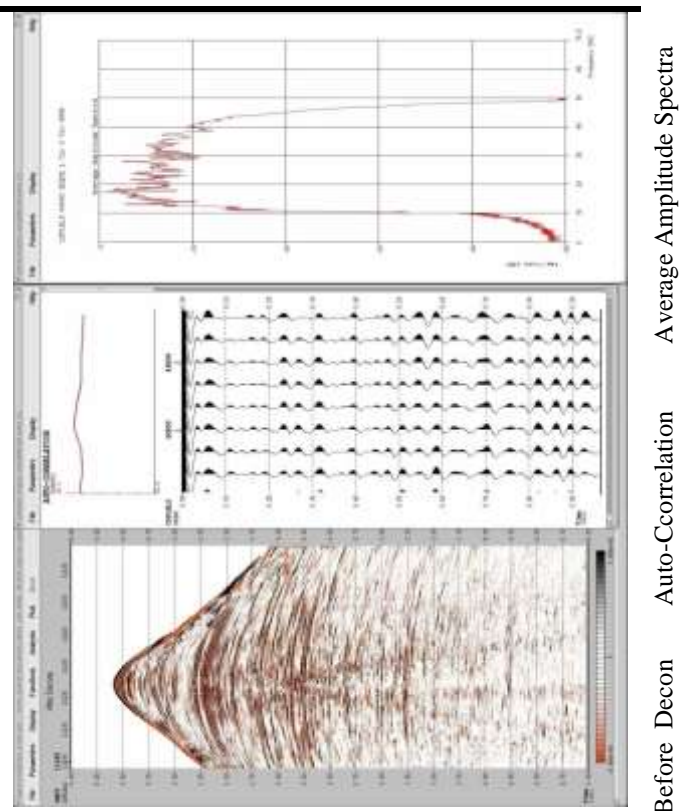


Fig.20: The autocorrelation result and the spectral analysis for the shot after DECON apply .

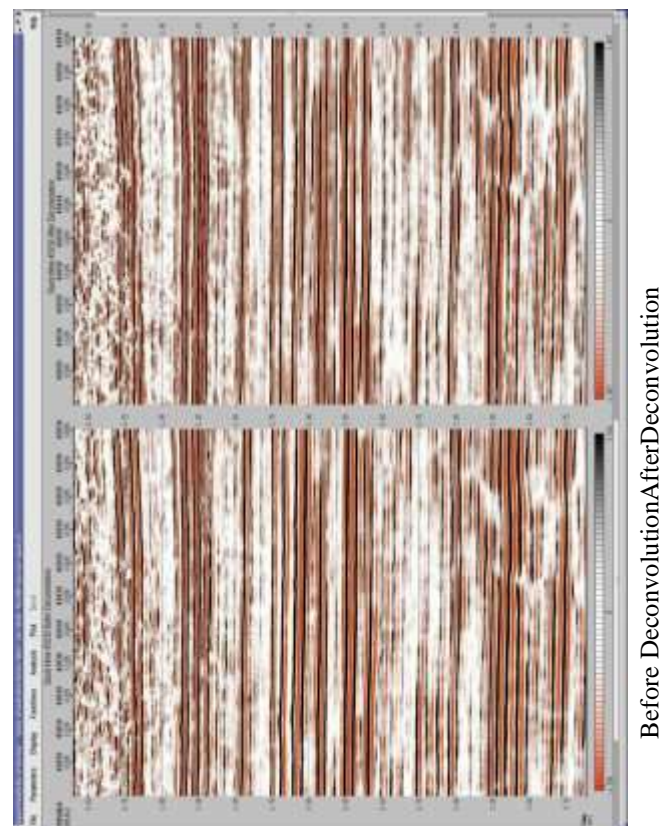


Fig.21: Stack inline 45030 before and after Deconvolution in Abu Amood oil field [8].

9- CMP Sort :-

The shot - ordered data were sorted into CMP gather .The data at this stage was extracted into in-lines groups this will simplify the run and the QCon data [6][7] Figure (22).

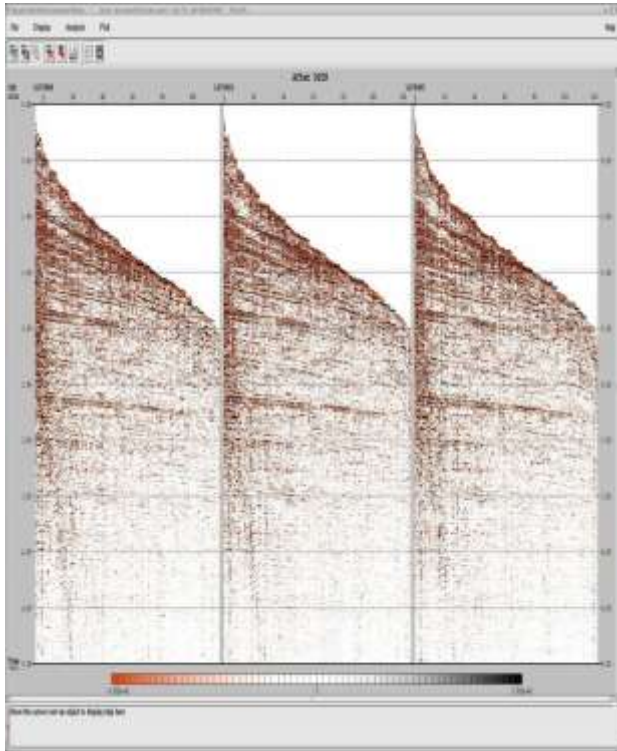


Fig.22: CMP Sort Data for Abu Amood oil field in Abu Amood oil field [8].

10- Stack Velocity Analysis (First Pass) :-

Velocity analysis were performed using programs VELDEF that require velocity , VELDEF doesn't processes seismic data for velocity function that stored by VELDEF which are accessed by other programs that process seismic data to apply Normal Move out Correction.

A regional velocity function taken from 2D line was applied for stacking. Initial velocity were picked every 48 inlines. With an in line spacing of 25 m this corresponds to 1.2 km spacing .The lines were chosen to be near minimum offset(near receiver line), ensuring availability of near traces information and a better handling of the shallow part of the analysis .The location on each line were chosen to be every 48 cross lines, yielding an analysis every 1.2 km. The input data was organized in inlines [9][10]Figure (23).

11-Residual Static Correction Calculation and Application:

Residual static correction removes any remaining short wavelength static shifts using reflection data to 'fine-tune' the initial static [9][10].figure (24)

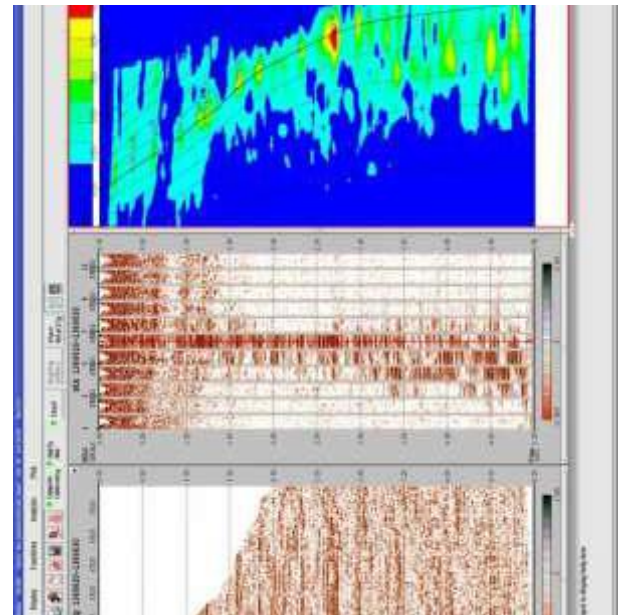


Fig.23: Shows the Velocity Analysis for Abu Amood oil field in Abu Amood oil field [8].

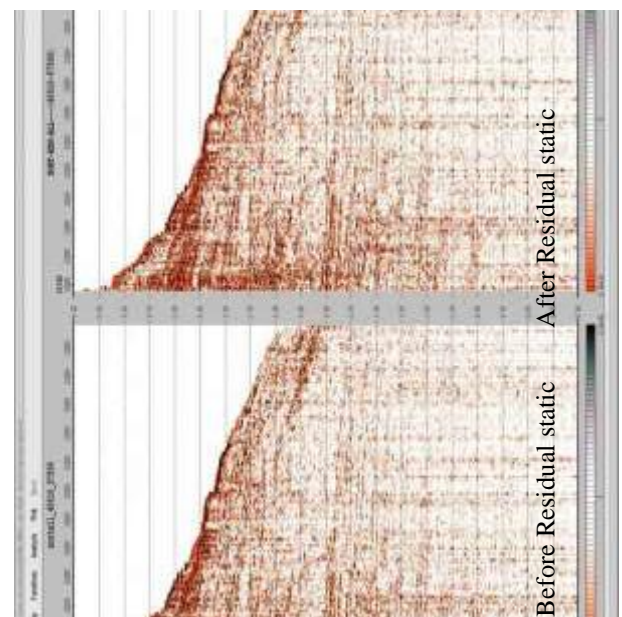


Fig.24: CDP Sort Data before and after Residual static in Abu Amood oil field [8].

12- Normal Move Out Correction / Mute / Stack:-

Normal Move Out (NMO) correction was applied on the CMP gathers , using final set of velocity of the field after residual static .

After (NMO), an outer trace mute was applied to remove first break noise, refraction and wide angle reflection and any stretched beyond acceptable limits. To prevent a rapid amplitude change between the muted and live parts of the trace in mute process, a 20 ms taper was applied from zero to full amplitude. This prevents distortion to the frequency spectrum of the stacked data, which would

otherwise by introduced by an abrupt boundary [9][10] figure (25).

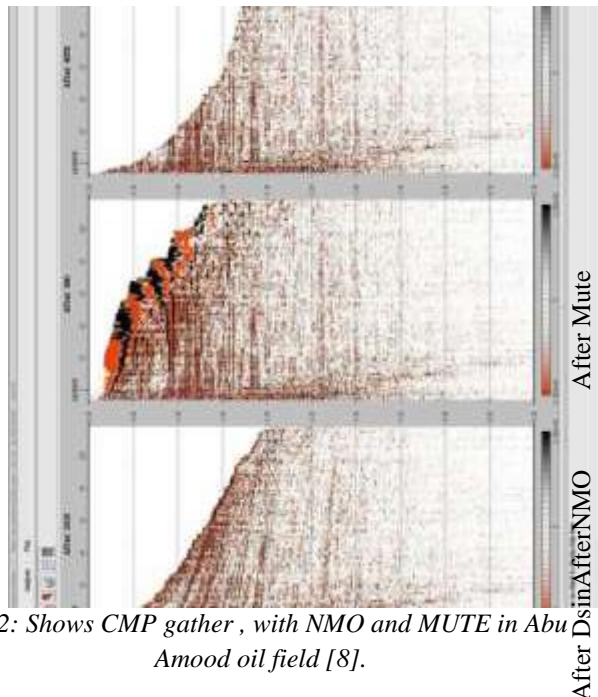


Fig.2: Shows CMP gather , with NMO and MUTE in Abu Amood oil field [8].

13-Post Stack Time Migration

Migration is a process which attempts to correct the distortions of the geological structure inherent in the seismic section. Migration re-distributes energy in the seismic section to better image of the true geological structures, or rearrange seismic data so that reflection events may be displayed at their true position in both space and time.

The post stack time migration in Geodepth collect RMS velocity volume migration in vertical functions window figure (26) and applying it in the main window of post stack time migration [9][10].

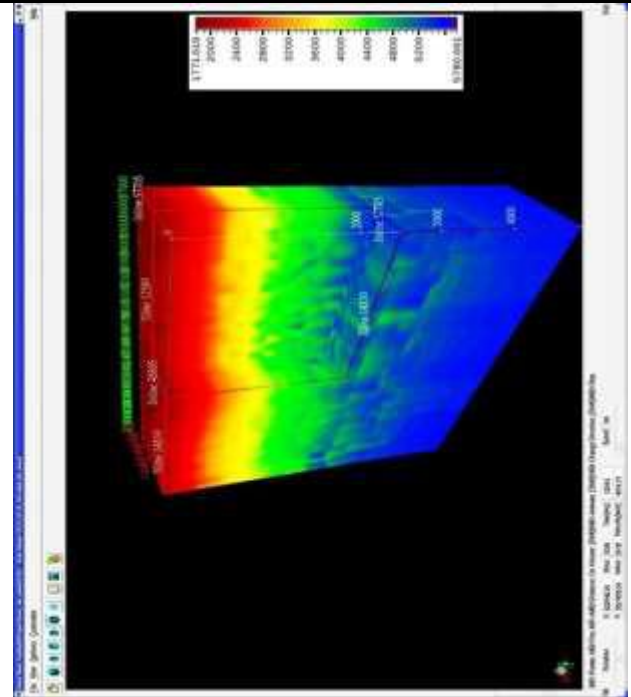


Fig.26: Shows 3D volume for RMS velocity volume to whole survey in Abu Amood oil field [8].

V. CONCLUSION

- 1- The Degrin of pattern survey was very good for this study.
- 2- The quality of seismic data was good quality.
- 3- Selected inline no. (49000) to carry out the test to determination the best standard of (noise test, signal test and geometry distribution pattern of vibrators.)
- 4- Through the implementation of several field tests, a major action plan was adopted as shown in table (1)(2)(3)(4).
- 5- The best signal source represent by four shocks (vibrators) are in work and one vibrators as reserve Type (NOMAD 65) with a maximum capacity (peak force) of (62000 LB) for each shock.

ACKNOWLEDGEMENT

I would like to express my deepest gratitude to my supervisor , **Assist. Prof. Dr. Salman Z. Khorshid** for her unwavering support ,collegiality and mentorshipthroughout this Thesis .

Many thanks to the Department of Geology, College of Science, and Baghdad University for providing the opportunities and facilities to accomplish this research.

My sincere thanks also goes the oil exploration company and its managers for providing me with all the necessary facilities for the research., especially to **Dr.Hassan Ali, Mr. Moamin AL-jumaili , Mr. Salar Hassan and Mr. Osama Salam** forhelping me in this project .

Last but not the least, I would like to thank my family: my parents and to my brothers and sister for supporting

me spiritually throughout writing this thesis and my life in general.

REFERENCES

- [1] Oil Exploration company, 2010, Exploration geologic study for Al-Rafidain-Garraf axis, oil exploration company, ministry of oil, unpublished study, 12p.
- [2] Oil Exploration company, 2013, Final field report of 3D seismic survey for Abo Amood field, internal report, ministry of oil, unpublished study, 15p.
- [3] Brown, A.R., 2003, Interpretation of Three Dimensional Seismic Data, AAPG Memoir 42, 3rd Ed., Tulsa, Oklahoma, 368 p.
- [4] Hart, Bruce S., 2004, Principle of 2D and 3D Seismic Interpretations, McGill University.
- [5] Kiran K. T., 2005, 2D and 3D Land Seismic Data Acquisition and Seismic Data Processing, College of Science and Technology, Andhra University, Andhra Pradesh, India, 1-116p.
- [6] Cordsen, A., Gabraith, M. and Peirce, J., 2000, Planning Land 3-D Seismic Surveys, Edited by Bob A. Hardage Series Editor: Stephen J. Hill, 199p.
- [7] Gijs, J. O., Vermeer, 2002, 3D Seismic Survey Design, by the society of Exploration Geophysicists, 12 GEOPHYSICAL REFERENCES SEIREIS, 205p.
- [8] OEC, 2011, seismic data processing report of Abo Amood 3D land survey, ministry of oil, unpublished study.
- [9] Yilmaz, O., 2001, seismic data analysis, series : processing, inversion, and interpretation of seismic data, V.1, P 173.
- [10] Yilmaz, O., 1987, seismic data processing, SEG series: Investigation Geophysics, V.2 526 p.